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*Stated Meeting, March 15, 1872.*

Present, 12 members.

Vice-President, Mr. FRALEY, in the Chair.

Prof. Edwin J. Houston, a newly elected member was presented to the presiding officer and took his seat.

Photographs for the album were received from Mr. George Davidson, U. S. Coast Survey, and from Prof. O. C. Marsh, of New Haven.

A letter requesting exchange of publication was received from Prof. C. F. Chandler, Editor of the *American Chemist*, dated School of Mines of Columbia College, corner of 49th St. and Fourth Avenue, New York, March 12, 1872. On motion, the *American Chemist* was ordered to be placed on the list of correspondents, to receive the Proceedings.

A circular letter was received from the Royal Academy of Sciences of Belgium, inviting the Society to assist at its Centennial Anniversary, May 28th and 29th next ensuing.

Letters of envoy were received from the P. O. Society at Königsberg, dated July 10, 1871, and from the Central Bureau of Statistics at Stockholm, dated Nov. 4, 1871.

Letters of acknowledgment were received from the Central Bureau of Statistics at Stockholm (81 to 85). Le Bureau des Longitudes, at Paris, dated Nov. 19, 1871 (82, 83); Feb. 14, 1872 (86). The Smithsonian Institute, Feb. 28, 1872 (87), and the Congressional Library, March 5, 1872 (XIV iii.).

Donations for the Library were received from the C. B. of Statistics of Sweden, the Society at Königsberg, the Royal Academy at Berlin, the K. K. Geological Institute and Anthropological Society at Vienna, the Royal Library at Munich, the Montsouris Observatory and Bureau des Longitudes at Paris, the *Revue Politique*, the Royal Geological Society of Cornwall, the Museum of Comparative Zoology at Cambridge, Mass.; the *American Journal of Science*, the New York Lyceum of Natural History, the Albany Institute, Prof. Chandler, the New Jersey Historical Society, the American Pharmaceutical Society, the Medical News and

Library, the Franklin Institute, the Penn Monthly, the Librarian of Congress, the Chief of U. S. Engineers, Senator Charles Sumner, and Prof. F. V. Hayden.

The death of Christian Olrik, of Denmark, a member of the Society, was announced by the Secretary.

The committee to which was referred the paper of Prof. Stevenson, on West Virginia Coal Measures, reported in favor of its publication in the Transactions, which on motion was so ordered.

A communication entitled, On some remarkable relations between the mean motions of Jupiter, Saturn, Uranus, and Neptune, received by letter from Prof. Daniel Kirkwood, dated Bloomington, Monroe County, Ind., March 11, 1872, was read by the Secretary.

ON SOME REMARKABLE RELATIONS BETWEEN THE MEAN MOTIONS OF JUPITER, SATURN, URANUS, AND NEPTUNE.

BY PROF. DANIEL KIRKWOOD.

(Read before the American Philosophical Society, March 15th, 1872.)

It was noticed by the writer several years since, that 85 periods of Jupiter are nearly equal to 12 of Uranus,\* and that 149 periods of Uranus are approximately equal to 76 of Neptune. If, therefore,  $n^v$ ,  $n^{vi}$ ,  $n^{vii}$  and  $n^{viii}$  denote the respective mean motions of Jupiter, Saturn, Uranus, and Neptune, these relations are expressed as follows :

$$\begin{aligned} 12n^v - 85n^{vii} &= 76n^{viii} - 149n^{viii}, \text{ nearly;} \\ \text{or, } 12n^v - 161n^{vii} + 149n^{viii} &= -\gamma \quad . \quad . \quad . \quad (1). \end{aligned}$$

With Newcomb's value of  $n^{viii}$  and the values of  $n^v$  and  $n^{vii}$  adopted in the *American Ephemeris*, we find  $\gamma = 390''$ . The equation,

$$32n^{vi} - 153n^{vii} + 121n^{viii} = -\gamma \quad . \quad . \quad . \quad (2),$$

was obtained by a process somewhat similar. Subtracting (2) from (1), and dividing by 4, we have

$$3n^v - 8n^{vi} - 2n^{vii} + 7n^{viii} = 0, \quad . \quad . \quad . \quad (3). \dagger$$

This equation, like that which exists between the mean motions of Jupiter's first three satellites, is doubtless exact. The mean motion of Neptune is less accurately known than those of the old planets. If we assume, then, that the received values of  $n^v$ ,  $n^{vi}$ ,  $n^{vii}$ , are correct,

\* Runkle's Mathematical Monthly, January, 1860,

† Equation (3), without any account of its discovery, was given in Silliman's Journal, March, 1872.